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ABSTRACT

Characteristics of postdoctoral students at Canadian universities are discussed and issues related to the training of postdoctoral students in Canada are explored. A survey conducted in 1972 indicated that there were 2,272 postdoctorals and research associates in the university sector. About 1,000 of these postdoctoral students were in mathematics or the physical sciences. Thirty percent were in the health sciences, and only 3.9 percent were in the human sciences. Ontario universities accounted for 42.3 percent of these students, and another third were in universities in the western provinces. Only 8.7 percent of these postdoctoral students were women. While 75 percent of the students were married, only about half of these had any children. About 22 percent of the postdoctoral students were Canadian citizens, but only 16.2 percent were Canadians by birth. Most of the foreign students came from Asia or Europe, and 18.3 percent came from the United States. Over 20 tables present data on the regional distribution, marital status, number of children, field of study, country of birth, country of citizenship, legal residence status (for foreign students), anticipated employment sector, country of employment, and career location of postdoctoral students. Some data are presented by field of study and/or by selected discipline. The assignment of the costs of training postdoctoral students and the need to examine future employment opportunities for these students are discussed briefly. (SC)

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THE POST-DOCTORAL POPULATION AT CANADIAN UNIVERSITIES

Post-doctoral education is a neglected area of research in Canada. A recent study in the United States spoke of the "Invisible University" and remarked that "post-doctoral activity takes place so unobtrusively and indeterminably that little note is taken of the event except by the participants".1/ This observation is equally applicable to the Canadian scene.

Although there have been two projects on post-doctorals at Ontario Universities which provided provincial information, there has never been a national study of Post-Doctoral Training in Canada.2/ Statistics Canada, which collects annually many statistical series on university education about students, faculty and finances, has never gathered information on the post-doctoral student population.

This paper focuses on post-doctoral student characteristics and to some extent the resources which are required for post-doctoral training in the university setting. It does not attempt to differentiate between the training and research functions of post-doctoral education, and does not evaluate the important research benefits which are derived from post-doctoral activities. The type and quality of post-doctoral research and its contribution to knowledge deserve further study.

There are at present approximately 2,500 post-doctoral students at Canadian universities in all fields of study receiving on the average, a $10,000 annual stipend and representing substantial additional expenses to the university. In most provinces, post-doctoral students are not part of the formula financing schemes, and consequently, the universities are not reimbursed for this type of expenditure. It is interesting to note that under the Federal-Provincial Fiscal Arrangements Act of 1967, and its extensions, the federal government absorbs about 50% of the educational costs for post-doctoral training, in addition to federal fellowship and research programs.

The financial assistance for post-doctoral students in the natural sciences is mostly derived from the National Research Council and the Medical Research Council of Canada. The National Research Council alone supports almost 1,000 post-doctoral students through its fellowship programs and through faculty research grants which are frequently used to maintain post-doctoral students. In addition, the Medical Research Council supports 300-400 post-doctorals in Canada and abroad.

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1/ National Academy of Sciences, The Invisible University, Washington, D.C., 1969.

2/ PAYTON, L.C., Post-Doctoral Education in the Ontario Universities, 1969-70; A Report Submitted to the Council of Ontario Universities, March 1972.

PAYTON, L.C., Post-Doctoral Education in the Ontario Universities, 1973-74; A Report Submitted to the Council of Ontario Universities, June 1975. (UNPUBLISHED MANUSCRIPT)

A post-doctoral appointment refers primarily to a position in research training to which a person is appointed following his/her completion of the requirements for a doctor's degree immediately after graduation. Occasionally a post-doctoral appointment occurs not immediately but after a number of years in the labor force or as a senior post-doctoral fellow on leave from a university. Yet, the numbers involved in these categories are rather small in Canada.

Post-doctoral appointments exist primarily in the natural sciences, particularly the physical sciences (e.g., chemistry, geology and physics), in the mathematical sciences, in engineering and the life sciences (e.g., agricultural and biological sciences) as well as in the health sciences, which means post-doctoral training in the medical, dental and other professional fields where they are frequently called research associates.

In Canada, the number of post-doctoral positions in the human sciences (e.g., the humanities and social sciences) is negligible except in psychology, and therefore most of the discussion will be limited to post-doctoral activities in the natural sciences.

Moreover, the following analysis does not consider post-doctoral positions in the federal and provincial government sector (such as in the Department of Agriculture and the National Research Council of Canada) and the appointments which exist in industry and non-profit organizations. It is estimated that less than 500 post-doctoral openings are altogether available annually in these sectors. In addition, in recent years, about 500 Canadians each year continued their research training at the post-doctoral level abroad, primarily in the United States and Great Britain, but this number has been gradually declining.

According to the National Research Council of Canada, there were in 1956 only 48 post-doctoral students in the natural sciences at Canadian universities, excluding appointments at medical schools.[3/] In 1967-68, the number had increased to 943, and continued to grow to 1,502 in 1971-72. At present, it has been estimated that there are 2,000 post-doctorals in the natural sciences excluding the health sciences at Canadian universities which indicates an annual growth rate of 13.3% since 1967-68.

In contrast, the total number of Ph.D.'s granted in Canada has not changed during the last three years, and is slightly less than 2,000 annually. For most natural science disciplines, there has actually been a decline in the number of Ph.D.'s produced, but this has

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3/ National Research Council of Canada, Projections of Manpower Resources and Research Funds 1968-1972 / Science and Engineering Research in Canadian Universities, February 1969.

been compensated by a larger number of Ph.D.'s granted for the humanities and social sciences. In the future, there will be a further decline in the number of Ph.D.'s graduated from Canadian universities due to the fact that the Ph.D. enrolment in many natural science disciplines has declined since the early 1970's.4/

The following section will discuss in greater detail the socio-economic characteristics and employment activities of post-doctoral students from Canadian universities.

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4/VON ZUR-MUEHLEN, M., Ph.D. Students in Canada, Secretary of State, Ottawa, August 1975.

PROFILE AND CHARACTERISTICS OF POST-DOCTORALS

As previously stated, there has never been a comprehensive study on "Post-doctorals at Canadian Universities".

During the first quarter of 1972, the National Research Council in conjunction with the Canada Council and the Medical Research Council, conducted the Tri-Council Survey of graduate students, including post-doctorals, at Canadian universities. The results of this survey have become recently available through Statistics Canada and will serve as a primary basis for the analysis. According to this 1972 survey, there were 2,272 post-doctorals and research associates in the university sector.

In the natural sciences, 43.3% or almost 1,000 of these post-doctoral students were in mathematics and the physical sciences.5/ (Table 1) In the other fields of study, 9.6% were in engineering, 13.2% were in the life sciences which include agriculture and the biological sciences, and 30% in the health sciences. Only 3.9% or 89 post-doctoral students were pursuing training in the human sciences which includes the humanities, social sciences and education.

The regional pattern by field of study shows some variation, but for all regions, mathematics and the physical sciences predominate. Quebec universities have a proportionately larger percentage (40.4%) in the health sciences as compared with a national average of 30.0%. The Western provinces have a larger percentage in the life sciences.

The regional or provincial distribution shows the following pattern, overall 42.3% of the post-doctoral students were studying at Ontario universities. (Table 2) Over one-third of the post-doctoral students were in the Western Provinces, particularly in Alberta and British Columbia. Quebec universities had only 18.6% of the post-doctoral students, and the Atlantic Region was also underrepresented (4.7%).

Only for the province of Ontario was it possible to ascertain the growth in the number of post-doctoral students since 1967-68. As mentioned above, Ontario accounted for 42.3% of the post-doctoral population in 1972 and it is likely that the growth pattern by field of study in the other provinces would have followed a similar trend. From 1967-68 to 1973-74, the number of post-doctoral students doubled in the natural sciences (excluding the health sciences) from 369 to 737. (Table 3) The percentage increase was particularly large for the two year period between 1969-70 and 1971-72 amounting to 35.4%. Since then, the growth rate between 1971-72 and 1973-74 declined to 18.3%. The number of post-doctoral students in the mathematical sciences increased

5/A recent "Survey of University Physics Departments for 1974" has identified 333 post-doctorals including some "term appointments" in physics. A similar survey in February 1975 by the University of Alberta Chemistry Post-doctoral Association noted that there were 543 Post-doctorals and research associates in chemistry at Canadian Universities.

more than three times from 17 to 59, and the post-doctorals in engineering more than doubled to over 100.

Since the largest number of post-doctoral students were in the physical and applied sciences, it is of interest to establish the relationship between Ph.D.'s granted and post-doctoral appointments immediately after graduation. Table 4 shows this relationship expressed in percentage terms from 1970-71 to 1973-74. Over one-third of the recent Ph.D. graduates continued their training at the post-doctoral level and this proportion varied slightly over time. The pattern which existed for Canada as a whole was very similar to that for Ontario.

The Tri-Council Survey provides rather interesting socio-economic information on post-doctoral students and their career aspirations from a sample of 767 post-doctoral students by fields of study and selected disciplines for 1972.6/

As can be expected, the proportion of female post-doctoral students was rather small (8.7%) and three-quarters of all post-doctoral students were married. (Tables 5 & 6) Almost 50% of the married post-doctoral students had no children and of the remainder, 48% had either one or two. (Tables 7 & 8) The majority of post-doctoral students were 30 years of age over with 10% being 35 years and older. (Table 9)

The country of birth of post-doctoral students indicates that for all fields of study only 16.2% were Canadians by birth in 1972. (Table 10) The proportion of Americans was 18.3%, Asian post-doctoral students accounted for 28.6% and 29.2% were Europeans. In engineering, the proportion of Canadians was as low as 2.7% whereas in contrast 54.8% were from Asia. In selected disciplines such as chemistry and physics, the proportion of Canadians were 14.7% and 17.1% respectively. (Table 11) In some of these physical science disciplines, there were substantially more from each of the following areas America, Britain, Europe and Asia than there were from Canada.

The citizenship breakdown indicates that the percentage of Canadian citizens was higher than the proportion born in Canada. (Table 12) Although 22.1% were Canadian citizens, 16.2% were Canadians by birth. This development could have been anticipated because a number of landed immigrants who had received their undergraduate and/or graduate training in Canada would have had an opportunity to acquire Canadian citizenship after the 5 year residence requirements. Similarly, some of the children of landed immigrants also changed their legal status. Nevertheless, the proportion of non-Canadians was substantial. In mathematics and the physical sciences,

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6/ For a detailed description of the Tri-Council Survey, see "Sources of Data", Ph.D. Students in Canada, Secretary of State, August 1975.

20.3% were Canadian citizens in 1972, 20.5% were Americans, 26.6% were Europeans and 25.5% were from Asia. In engineering, there were 5.5% who were Canadian citizens as compared with 53.4% from Asia. In chemistry as in physics, there were as many or more from each country such as the United States, Great Britain and some Asian countries as there were from Canada. (Table 13)

Table 14 shows that 62% of the foreign born post-doctorals were in the landed immigrant category and 38.0% classified themselves as foreign students. This pattern existed for all fields of study. For some selected disciplines the proportion of foreign students in comparison with landed immigrants was higher, such as mathematics and chemistry. (Table 15)

In the first quarter of 1972, 80% indicated that they had obtained their landed immigrant status between 1969 and 1971. (Table 16) Only 4.5% had become landed immigrants before 1967. There was slight variation among selected disciplines as to when landed immigrant status was obtained. (Table 17)

The post-doctoral students were asked to identify their anticipated employment sector and 80.7% indicated that they would prefer university employment. (Table 18) Even in engineering, 78.9% showed a preference for university employment as compared with 17.6% for industry. For all fields of study, 5.1% of the post-doctoral students expressed a preference for government employment with a high of 9.2% in agriculture and biological sciences and a low of 3.5% in engineering.

The Council of Ontario Universities has conducted two surveys of the employment of post-doctorals from Ontario universities in the natural sciences, in 1969-70 and in 1973-74. (Table 19) Whereas, in 1969-70, 73.1% obtained employment in the university sector, this proportion declined to 54.5% in 1973-74. This decline was particularly marked for the physical sciences. The percentage of post-doctorals who obtained appointments in government almost doubled for the physical sciences from 10.2% in 1969-70 to 18.1% in 1973-74. For all fields of study, the proportion of post-doctorals who went into industry increased from 16.2% to 26.1% but it should be remembered that in absolute numbers, the figures involved were only 38 and 55 respectively.

For the same group, the country of employment was also available. (Table 20) Whereas in 1969-70, 39.6% obtained employment in Canada, in 1973-74 this proportion was 51.4%. In both years, almost every fifth post-doctoral student went to the United States for employment. In 1969-70, 28.3% went to Europe including the United Kingdom, however, in 1973-74, this percentage declined to 12.5%. There was some variation among the four fields of study but the overall trend was the same: more post-doctorals remained in Canada in 1973-74 than in 1969-70.

The Tri-Council Survey enquired about the preference for career location, 62.8% expressed a preference to continue their career in Canada, 28.7% outside of Canada and the balance of 8.5% indicated a preference for both, either in Canada or outside. There existed some variation in this pattern for the various fields of study and selected

disciplines. For example, in chemistry, only 53.4% expressed an interest in a career location in Canada whereas 33.6% indicated a preference outside Canada and 13.0% for both. (Table 22)

The profile and characteristics of post-doctoral students at Canadian universities raise a number of issues which will be discussed in the next section.

SOME UNRESOLVED ISSUES OF POST-DOCTORAL TRAINING IN CANADA

As already mentioned in the introduction, post-doctorals at Canadian universities are in many ways rather invisible. Not only is it difficult to ascertain the total number, but also their role and functions are ill-defined.

In many provinces, the universities are not directly reimbursed for the expenditures which occur in the training and employment of post-doctoral students. It could be speculated that often universities direct the income they receive on a per capita basis from the provinces for undergraduate and graduate education to post-doctoral training. Therefore, there is a need from a budgetary point of view to identify much more clearly the financial resources which are expended on post-doctoral training and as a corollary, the question arises as to what level of government should assume the major responsibility.

From the post-doctoral student point of view, there are indications of dissatisfaction. Since post-doctorals are neither students nor faculty, their legal status is obscured. In most instances, they are not entitled to Workmans' Compensation, Unemployment Insurance, Canada Pension Plan or other benefits and are not part of the hierarchical structure of the university.

In the natural sciences, they are reimbursed according to guidelines developed by the National Research Council which at present is approximately $10,000 annually. In contrast, in 1967, the average post-doctoral fellowship amounted to $6,000 which was not taxed. Since the consumer price index has increased from 115.4 in 1967 to over 180.0 in the summer of 1975 and, since this income is now taxable, the income of the average post-doctoral should be in the neighbourhood of $12,000 provided that the 1967 income level was considered appropriate.

Another dimension to this income question is the fact that over one-third of the post-doctoral students have been involved in post-doctoral activities for more than two years, yet, they are not compensated for their post-doctoral experience. Out of necessity, since employment opportunities appear to be limited, they are forced to continue their training at the post-doctoral level in a "holding pattern" type of situation. For those post-doctorals who cannot obtain permanent employment, this is the only opportunity to remain in touch with their discipline. Concern has also been expressed that the average post-doctoral student is now over 30 years old and still in training. There are reported cases of post-doctorals who have five or more years training at this level. Industry in particular does not appear to be prepared to employ older Ph.Ds with many years of post-doctoral training at an adequate salary level.

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In recent years, a reserve army of potential university teachers, some speak of an academic proletariat, has been created which performs a valuable research function without adequate financial rewards or promising career opportunities.

From a university faculty point of view for most of the natural sciences, this situation is rather advantageous. Through their faculty research grants from the National Research Council and other sources, the university teachers are in the position to acquire skilled research capabilities at low cost in comparison with the less well trained graduate students or technical support personnel.

The National Research Council, through its faculty research grants amounting to $37.8 million in 1972-73 provides substantial financial resources to hire many of these post-doctorals in addition to their regular post-doctoral fellowship programs. It has been estimated that at least half of all post-doctorals in the natural sciences are directly or indirectly supported through this granting council.

At this point, one is hesitant to judge if there are too many or too few post-doctorals being supported. Yet, from a manpower approach, there are clear indications that cumulative surpluses exist for most of the science disciplines although in certain specialized areas within each discipline, there might exist shortages. As an illustration, the results of a survey of post-doctorals in mathematics at Canadian universities conducted by the Science Council of Canada is of interest. This study identified over 150 post-doctorals and research associates in mathematics at Canadian universities in 1972-73. The large majority of these were trained in "pure" mathematics and rather few in statistics and computer science where substantial employment opportunities exist. The Ontario data indicated, for example, that the government had not employed one mathematics post-doctoral in 1969-70 or in 1973-74. (Table 19) The demand in the university sector is almost non-existent at present, especially for "pure" mathematicians.

Information from the United States shows that there are only about 300 post-doctorals in mathematics as compared with over 150 in Canada. Moreover, only one-third of the U.S. universities which offer a doctoral program in mathematics have post-doctoral students. In Canada, this situation is somewhat different.

On a discipline basis, one needs to determine what proportion of Ph.D. holders should continue their training at the post-doctoral level. As an illustration, in the U.S. during the sixties, less than 10% of the Ph.D. holders in mathematics continued their training at the post-doctoral level. In Canada, this proportion appeared to be much higher.

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Similarly in the physical sciences, such as chemistry and physics, the proportion of Ph.D. graduates who continued in post-doctoral education was in excess of 35% in Canada. The training at the post-doctoral level was supposed to be geared for subsequent employment in highly research oriented universities. Since the employment prospects have declined substantially in the university sector, and since some doubts have been expressed that such a large percentage of Ph.D. graduates are suitable for this type of post-doctoral training, an unresolved issue exists. Since in most cases the training of post-doctorals is university oriented, most post-doctorals have limited employment opportunities in industry and government where different and additional qualifications are required.

There are indications that employment opportunities for Ph.Ds with post-doctoral training are scarce. It appears also that the salary levels offered to this group are not attractive. This might partially explain the reservations Canadian Ph.Ds have in pursuing post-doctoral study. Also, foreign born post-doctorals are experiencing difficulties obtaining positions in industry and government.

Within an historical context, research and development activities in the industrial sector in Canada had been de-emphasized by the large international corporations, therefore, the potential employment opportunities for post-doctorals in this sector have remained limited and there might be a need to re-examine the prospects in this area.

Another unresolved issue is the composition of post-doctorals by country of origin. Historically most countries such as Germany in the 19th century and the United States since World War II, had a large proportion of post-doctorals who were foreign. This arrangement appeared to be mutually advantageous and provided the best environment for developing an international research elite. In the past few years, fewer Canadians have pursued their post-doctoral training abroad and at the same time employment opportunities abroad, particularly in the United States, for Ph.Ds with post-doctoral training have declined substantially.

As previously discussed, 83.8% of all post-doctorals at Canadian universities were foreign born. Although the majority of the foreign born post-doctorals had obtained landed immigrant status under liberal immigration criteria, a number of those in this category had come to Canada primarily for the purpose of study rather than to become permanent residents of this country. There is a need for clarification whether a post-doctoral appointment at a Canadian university could be regarded as 'prearranged' employment under present immigration regulations.

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In the past, many prospective post-doctorals were encouraged by the university community to enter the country as landed immigrants rather than as foreign students. The immigrant status presented more advantages. For this purpose, the university community provided the potential post-doctoral students with an employment letter as research assistant, teaching fellow or demonstrator which facilitated the entry as a landed immigrant. Many of them originally did not intend to settle in Canada.

Although Canada has an international commitment to train foreign post-doctorals, the present composition by country of origin is a cause for concern. This does not appear to reflect a conscious policy of the federal and provincial governments and a better balance seems to be required.

By definition, these highly trained and motivated persons represent a valuable resource if opportunities exist to utilize their talents. Since teaching positions are scarce in the university sector and will remain so for the foreseeable future and, since alternative employment opportunities are limited, there is a danger that human resources have been underutilized at substantial financial and social costs. Many post-doctorals will have difficulties attaining their career objectives.

Although it is almost an impossible task to determine how many post-doctorals Canada should train, there is a need to develop guidelines. For example, it is unlikely that Canada will be in a position to substantially expand its chemical industry - is it therefore necessary to have over 500 post-doctorals annually in chemistry? What proportion of Ph.D. graduates should be encouraged to continue their post-doctoral training and what percentage of these should be funded through fellowship schemes? At present, the number of post-doctorals in certain disciplines is strongly influenced by the research grants which are made available to university teachers through the Research Councils. In this context, it is of interest to note that most grants to the university community do not take into account the overhead expenditures required in conjunction with these grants. Consequently, the universities have to absorb these additional costs which have an impact on their expenditure patterns.

It is the freedom of choice the individual university professor has as to how he spends his research grant which eventually determines the number of post-doctorals at Canadian universities. From an individual perspective, it is a wise research decision but viewed collectively, it has serious manpower implications as well as affecting the research priorities of the universities.

The number of post-doctorals continue to grow in the natural sciences by about 10% annually although graduate enrolment has levelled off or declined in recent years. This trend requires attention as does the fact that there are so few post-doctorals in the humanities and social sciences where there appears to be a need for expansion.

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Recently, the Canada Council has discontinued its rather small post-doctoral fellowship program for the humanities and social sciences. Since the replacement rate of full training university faculty will be in the neighborhood of 1% annually, the number of replacement openings for full-time teaching positions will be less than 200 annually for the foreseable future. Therefore, for the humanities and social sciences, it might be advisable to create for the best Ph.D. graduates who could not obtain university teaching appointments, positions as research associates within the university environment as a temporary measure. At the same time, one might explore the feasibility of developing permanent research capabilities within universities which would be distinct from the teaching functions of most university teachers.

In the university sector, it appears that a large part of research is carried out by post-doctorals and the question arises, is that the most efficient and economical way to carry out research?

Post-doctorals themselves have expressed their uneasiness about their legal status within the university environment and the lack of recognition they receive, particularly with regard to income and fringe benefits, considering that more than three-quarters of them are married.

It is of interest to note that only about 50% of the post-doctorals in the Natural Sciences at Canadian universities are, directly or indirectly, supported through the National Research Council and the Medical Research Council, the other 50% must obtain their stipends or income through financial resources of the universities.

Post-doctoral education in Canada was seldom planned but simply occured. There is a need to explore not only the future employment opportunities of post-doctorals but also to investigate the type and quality of post-doctoral training at the universities as well as in government and in industry.

TABLE 1

POST-DOCTORAL STUDENTS BY FIELD OF STUDY
ON A REGIONAL BASIS*, 1972

	HUMAN SCIENCES	MATHEMATICS & PHYSICAL SCIENCES	ENGINEERING & APPLIED SCIENCES	LIFE SCIENCES	HEALTH SCIENCES	TOTAL
Atlantic Provinces	17 (15.9)	61 (57.0)	8 (7.5)	4 (3.7)	17 (15.9)	107 (100.0)
Quebec	13 (3.1)	113 (26.7)	57 (13.5)	69 (16.3)	171 (40.4)	423 (100.0)
Ontario	35 (3.6)	446 (46.4)	87 (9.0)	90 (9.4)	304 (31.6)	962 (100.0)
Western Provinces	24 (3.1)	364 (46.7)	68 (8.7)	135 (17.3)	189 (24.2)	780 (100.0)
TOTAL	89 (3.9)	984 (43.3)	220 (9.6)	298 (13.2)	681 (30.0)	2,272 (100.0)

*Percentage figures in brackets.

Source: Tri-Council Survey, unpublished data.

TABLE 2

POST-DOCTORAL STUDENTS AT CANADIAN UNIVERSITIES BY REGION OR PROVINCE*, 1972

	HUMAN SCIENCES	MATHEMATICS & PHYSICAL SCIENCES	ENGINEERING & APPLIED SCIENCES	LIFE SCIENCES	HEALTH SCIENCES	TOTAL
Atlantic Region	17 (19.1)	61 (6.2)	8 (3.6)	4 (1.3)	17 (2.5)	107 (4.7)
Quebec	13 (14.6)	113 (11.5)	57 (25.9)	69 (23.2)	171 (25.1)	423 (18.6)
Ontario	35 (39.3)	446 (45.3)	87 (39.6)	90 (30.2)	304 (44.6)	962 (42.3)
Manitoba	1 (1.1)	32 (3.3)	10 (4.6)	22 (7.4)	63 (9.3)	128 (5.6)
Saskatchewan	1 (1.1)	43 (4.4)	8 (3.6)	37 (12.4)	23 (3.4)	112 (4.9)
Alberta	15 (16.9)	143 (14.5)	28 (12.7)	37 (12.4)	59 (8.7)	282 (12.4)
British Columbia	7 (7.9)	146 (14.8)	22 (10.0)	39 (13.1)	44 (6.5)	258 (11.4)
TOTAL	89 (100.0)	984 (100.0)	220 (100.0)	298 (100.0)	681 (100.0)	2,272 (100.0)

* Figures in brackets represent percentage distribution by region or province.
Source: Tri-Council Survey, unpublished data.

TABLE 3

POST-DOCTORAL STUDENTS IN THE NATURAL SCIENCES AT ONTARIO UNIVERSITIES, 1967-68 TO 1973-74

	PHYSICAL SCIENCES	PERCENTAGE CHANGE	MATHEMATICAL SCIENCES	PERCENTAGE CHANGE	ENGINEERING	PERCENTAGE CHANGE	LIFE SCIENCES	PERCENTAGE CHANGE	TOTAL*	PERCENTAGE CHANGE
1967-68[1/]	250		17		50		52		369	
		16.4		64.7		[illegible]		57.7		24.7
1969-70[2/]	291		28		59		82		460	
		36.8		71.4		47.5		8.5		35.4
1971-72[3/]	398		48		87		90		623	
		18.7		26.2		18.0		16.7		18.3
1973-74[2/]	470		59		103		105		737	

Sources: [1/] Estimated from National Research Council of Canada data.

[2/] Adapted from Council of Ontario Universities data.

[3/] Tri-Council Survey, unpublished data.

* excludes the Health Sciences

TABLE 4

RELATIONSHIP BETWEEN PH.D.'S GRANTED AND POST-DOCTORAL APPOINTMENTS IN THE PHYSICAL AND APPLIED SCIENCES IMMEDIATELY AFTER PH.D. GRADUATION*, 1970-71 TO 1973-74

	CANADA			ONTARIO		
	PH.D.'S GRANTED	POST-DOCTORALS	PERCENT	PH.D.'S GRANTED	POST-DOCTORALS	PERCENT
1970-71	659	232	35.2	305	118	38.7
1971-72	669	249	37.2	369	137	37.1
1972-73	746	277	37.1	408	150	36.8
1973-74	705	244	34.6	349	122	35.0

Source: Adapted from Statistics Canada data and the Canadian Association of Graduate Schools data.
*Physical and applied sciences include mathematics, engineering and the physical sciences.

TABLE 5

MARITAL STATUS OF POST DOCTORAL STUDENTS
BY FIELD OF STUDY, 1972
(in percent)

Field of Study	Married	Not Married	Total Number
Social Sciences	76.9	23.1	13
Education	100.0	- -	1
Humanities, Languages & Fine Arts	66.7	33.3	6
Agriculture & Biological Sciences	72.7	27.3	66
Engineering & Applied Sciences	71.2	28.8	73
Mathematics & Physical Sciences	74.8	25.2	441
Health Professions & Occupations	78.0	22.0	164
Total	75.0	25.0	764

Source: Tri-Council Survey, unpublished data.

TABLE 6

MARITAL STATUS OF POST DOCTORAL STUDENTS
BY SELECTED DISCIPLINE, 1972
(in percent)

Selected Discipline	Married	Not Married	Total Number
Psychology	71.4	28.6	7
Biology, Botany & Zoology	71.1	28.9	38
Computer Sciences, Applied Mathematics & Mathematics	43.8	56.2	32
Chemistry	76.7	23.3	249
Geology and Related	80.0	20.0	20
Physics	77.9	22.1	140

Source: Tri-Council Survey, unpublished data.

TABLE 7

NUMBER OF CHILDREN OF POST-DOCTORAL STUDENTS
BY FIELD OF STUDY, 1972
(in percent)

Field of Study	0	1	2	3	4	5	NUMBER OF STUDENTS
Social Sciences	20.0	50.0	30.0	- -	- -	- -	10
Education	100.0	- -	- -	- -	- -	- -	1
Humanities, Languages & Fine Arts	50.0	25.0	- -	25.0	- -	- -	4
Agriculture & Biological Sciences	39.6	35.4	18.7	2.1	2.1	2.1	48
Engineering & Applied Sciences	50.0	28.8	17.3	3.9	- -	- -	52
Mathematics & Physical Sciences	49.7	30.0	17.3	2.7	0.3	- -	330
Health Professions & Occupations	49.2	25.0	21.9	3.9	- -	- -	128
Total	48.3	29.5	18.5	3.1	0.4	0.2	573

Source: Tri-Council Survey, unpublished data

TABLE 8

NUMBER OF CHILDREN OF POST-DOCTORAL STUDENTS
BY SELECTED DISCIPLINE, 1972
(in percent)

Selected Discipline	0	1	2	3	4	5	NUMBER OF STUDENTS
Psychology	40.0	40.0	20.0	- -	- -	- -	5
Geography	- -	50.0	50.0	- -	- -	- -	2
Agriculture	20.0	40.0	40.0	- -	- -	- -	5
Biology, Botany & Zoology	37.0	37.0	18.6	3.7	3.7	- -	27
Computer Sciences, Applied Mathematics & Mathematics	35.7	35.7	28.6	- -	- -	- -	14
Chemistry	50.3	31.4	17.3	0.5	0.5	- -	191
Geology and Related	43.8	43.8	12.4	- -	- -	- -	16
Physics	51.4	24.8	16.5	7.3	- -	- -	109

Source: Tri-Council Survey, unpublished data

TABLE 9

Age Distribution of Post-Doctoral Students by Selected Field of Study, 1972 (in percent)

	27 years or less	28 yrs.	29 yrs.	30 yrs.	31 yrs.	32 yrs.	33 yrs.	34 yrs.	35 yrs.	36 yrs.	37 yrs. (& over)	Total
AGRICULTURE & BIOLOGICAL SCIENCES	9.1	16.7	15.2	12.1	10.6	9.1	3.0	6.1	4.5	1.5	12.1	66
ENGINEERING	8.3	12.5	11.1	8.3	12.5	11.1	5.6	8.3	5.6	4.2	12.5	72
MATHEMATICS & PHYSICAL SCIENCES	14.2	12.7	14.7	14.5	10.0	9.7	4.8	4.5	4.1	1.8	9.0	442
HEALTH PROFESSIONS AND OCCUPATIONS	11.0	15.9	14.6	9.1	13.4	6.7	9.8	8.5	3.7	2.4	4.9	164

Source: Tri-Council Survey, unpublished data.

TABLE 10

COUNTRY OF BIRTH OF POST DOCTORAL STUDENTS
BY FIELD OF STUDY, 1972
(in percent)

Field of Study	Canada	U.S.A.	Great Britain	France	Other European	South Pacific	Asia	Mediterr-anean and Middle East	Central and South America	Caribb-ean	Africa	Total Number
Social Sciences	30.8	23.0	7.7	- -	23.0	15.4	- -	- -	- -	- -	- -	13
Humanities, Languages & Fine Arts	33.3	16.7	16.7	- -	33.3	- -	- -	- -	- -	- -	- -	6
Agriculture & Biological Sciences	21.2	19.7	22.7	1.5	4.5	- -	22.7	3.0	- -	1.5	3.0	66
Engineering & Applied Sciences	2.7	1.4	9.6	- -	15.1	2.7	54.8	9.6	- -	- -	4.1	73
Mathematics & Physical Sciences	15.1	20.3	15.1	2.0	13.7	2.9	27.3	1.1	0.5	1.1	0.9	444
Health Professions & Occupations	21.3	18.9	15.2	3.1	7.9	3.1	26.2	1.8	0.6	1.2	0.6	164
Total	16.2	18.3	15.1	2.0	12.1	2.9	28.6	2.2	0.4	1.0	1.3	767

Source: Tri-Council Survey, unpublished data.

TABLE 11

COUNTRY OF BIRTH OF POST DOCTORAL STUDENTS
BY SELECTED DISCIPLINE, 1972
(in percent)

Selected Discipline	Canada	U.S.A.	Great Britain	France	Other European	South Pacific	Asia	Mediterranean and Middle East	Central and South America	Caribbean	Africa	Total Number
Biology, Botany & Zoology	23.7	21.1	21.1	2.6	5.2	- -	18.4	5.2	- -	- -	2.6	38
Computer Sciences, Applied Mathematics & Mathematics	6.3	15.6	9.4	- -	28.1	3.1	34.4	- -	- -	5.1	- -	32
Chemistry	14.7	19.4	15.9	3.2	10.3	3.6	29.8	0.8	0.4	1.2	0.8	252
Geology and Related	20.0	15.0	10.0	- -	20.0	- -	30.0	- -	- -	- -	5.0	20
Physics	17.1	23.6	15.7	0.7	15.7	2.1	20.7	2.1	0.7	0.7	0.7	140

Source: Tri-Council Survey, unpublished data.

TABLE 12

COUNTRY OF CITIZENSHIP OF POST-DOCTORAL STUDENTS BY FIELD OF STUDY, 1972

(in percent)

Field of Study	Canada	U.S.A.	Great Britain	France	Other European	South Pacific	Asia	Mediterr-anean and Middle East	Central and South America	Caribb-ean	Africa	Total Number
Social Sciences	30.8	30.8	7.6	0.0	15.4	15.4	0.0	0.0	0.0	0.0	0.0	13
Humanities, Languages & Fine Arts	66.7	0.0	16.7	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	6
Agriculture & Biological Sciences	30.8	21.5	21.5	1.5	3.1	0.0	16.9	3.1	0.0	1.5	0.0	65
Engineering & Applied Sciences	5.5	1.4	9.6	0.0	13.7	2.7	53.4	9.6	0.0	0.0	4.1	73
Mathematics & Physical Sciences	20.3	20.5	14.0	1.6	11.0	3.8	25.5	0.9	0.5	0.9	1.1	444
Health Professions & Occupations	28.7	18.9	15.9	1.8	6.1	3.7	21.3	1.8	0.0	1.2	0.6	164
Total	22.1	18.5	14.5	1.4	9.7	3.5	25.8	2.1	0.3	0.9	1.2	765

Source: Tri-Council Survey, unpublished data.

TABLE 13

COUNTRY OF CITIZENSHIP OF POST-DOCTORAL STUDENTS BY SELECTED DISCIPLINE, 1972

(in percent)

Selected Discipline	Canada	U.S.A.	Great Britain	France	Other European	South Pacific	Asia	Mediterr-anean and Middle East	Central and South America	Caribb-ean	Africa	Total Number
Biology, Botany & Zoology	29.8	24.3	21.6	2.7	2.7	0.0	13.5	5.4	0.0	0.0	0.0	37
Computer Sciences, Applied Mathematics & Mathematics	18.8	18.8	6.2	0.0	21.9	3.1	28.1	0.0	0.0	3.1	0.0	32
Chemistry	18.7	19.0	15.5	2.8	7.9	4.0	28.6	0.8	0.4	1.2	1.2	252
Geology and Related	20.0	15.0	5.0	0.0	20.0	5.0	30.0	0.0	0.0	0.0	5.0	20
Physics	23.6	24.3	14.3	0.0	12.9	3.6	18.6	1.4	0.7	0.0	0.7	140

Source: Tri-Council Survey, unpublished data.

TABLE 14

LEGAL RESIDENCE STATUS OF FOREIGN POST-DOCTORAL STUDENTS
BY FIELD OF STUDY, 1972
(in percent)

Field of Study	Landed Immigrant	Foreign Students	Total Number
Social Sciences	77.8	22.2	9
Education	- -	100.0	1
Humanities, Languages & Fine Arts	50.0	50.0	2
Agriculture & Biological Sciences	56.5	43.5	46
Engineering & Applied Sciences	55.1	44.9	69
Mathematics & Physical Sciences	60.3	39.7	355
Health Professions & Occupations	72.9	27.1	118
Total	62.0	38.0	600

Source: Tri-Council Survey, unpublished data.

TABLE 15

LEGAL RESIDENCE STATUS OF FOREIGN POST-DOCTORAL STUDENTS BY SELECTED DISCIPLINE, 1972
(in percent)

Selected Discipline	Landed Immigrant	Foreign Students	Total Number
Biology, Botany & Zoology	55.6	44.4	27
Computer Sciences, Applied Mathematics & Mathematics	50.0	50.0	26
Chemistry	59.0	41.0	205
Geology and Related	56.3	43.7	16
Physics	65.7	34.3	108

Source: Tri-Council Survey, unpublished data.

TABLE 16

Year of Obtained Landed Immigrant Status of Post-Doctoral Students by Field of Study, 1972 (in percent)

Field of Study	1971 %	1970 %	1969 %	1968 %	1967 %	1966 %	1950-1965 %	Total Number
Social Sciences	57.1	28.6	-	-	-	-	14.3	7
Agriculture & Biological Sciences	44.0	16.0	8.0	28.0	4.0	-	-	25
Engineering	28.6	31.5	17.1	17.1	5.7	-	-	35
Math. and Physics	33.0	27.7	20.9	11.2	3.9	1.4	1.9	206
Health and Medicine	32.5	27.7	19.3	9.7	1.2	7.2	2.4	83
Total	33.9	27.2	18.8	12.3	3.3	2.5	2.0	356

Source: Tri-Council Survey, unpublished data.

TABLE 17

Year of Obtained Landed Immigrant Status of Post-Doctoral Students by Selected Discipline, 1972 (in percent)

Selected Discipline	1971	1970	1969	1968	1967	1966	1950-1965	Number
Biology, Botany & Zoology	46.7	13.3	6.7	26.6	6.7	-	-	15
Computer Sc., Applied Math. and Math	8.3	25.0	33.4	16.7	8.3	-	8.3	12
Chemistry	34.2	30.8	16.2	10.3	5.1	2.6	0.8	117
Geology and Related	22.3	33.3	33.3	11.1	-	-	-	9
Physics	36.8	22.0	25.0	11.8	1.5	-	2.9	68

Source: Tri-Council Survey, unpublished data.

TABLE 18

ANTICIPATED EMPLOYMENT SECTOR OF POST-DOCTORAL STUDENTS
BY FIELD OF STUDY, 1972
(in percent)

Field of Study	Government	University	Community College	Elementary & Secondary Schools	Hospital	Industry	Private Practice	Total Number
Agriculture & Biological Sciences	9.2	83.3	- -	- -	3.7	1.9	1.9	54
Engineering & Applied Sciences	3.5	78.9	- -	- -	- -	17.6	- -	57
Mathematics & Physical Sciences	5.3	79.2	1.1	0.3	0.5	13.3	0.3	360
Health Professions & Occupations	4.2	81.7	0.7	- -	8.5	4.9	- -	142
Total	5.1	80.7	0.8	0.2	2.5	10.4	0.3	631

Source: Tri-Council Survey, unpublished data

TABLE 19

EMPLOYMENT SECTOR OF POST-DOCTORAL STUDENTS IN THE NATURAL SCIENCES FROM ONTARIO*, 1969-70 AND 1973-74

	UNIVERSITIES		GOVERNMENT		INDUSTRY		OTHER		TOTAL NUMBER	
	1969/70	1973-74	1969/70	1973-74	1969/70	1973/74	1969/70	1973/74	1969/70	1973/74
Physical Sciences	115 (73.2)	53 (45.7)	16 (10.2)	21 (18.1)	26 (16.6)	36 (31.0)	-- --	6 (5.2)	157 (100.0)	116 (100.0)
Mathematical Sciences	25 (89.3)	24 (85.7)	-- --	-- --	3 (10.7)	3 (10.7)	-- --	1 (3.6)	28 (100.0)	28 (100.0)
Engineering	13 (68.4)	23 (53.5)	1 (5.3)	5 (11.6)	5 (26.3)	14 (32.6)	-- --	1 (2.3)	19 (100.0)	43 (100.0)
Life Sciences	18 (60.0)	15 (62.5)	6 (20.0)	5 (20.8)	4 (13.3)	2 (8.3)	2 (6.7)	2 (8.3)	30 (100.0)	24 (100.0)
TOTAL	171 (73.1)	115 (54.5)	23 (9.8)	31 (14.7)	38 (16.2)	55 (26.1)	2 (.9)	10 (4.7)	234 (100.0)	211 (100.0)

Other: High School, Non-Profit Organizations, Self-Employment excluding "not known", and those continuing Post-Doctoral Education.

*: Percentage figures in brackets.

Source: Adapted from data of the Council of Ontario Universities.

TABLE 20

COUNTRY OF EMPLOYMENT OF POST-DOCTORAL STUDENTS IN THE NATURAL SCIENCES FROM ONTARIO*, 1969-70 AND 1973-74

	CANADA		U.S.A.		UNITED KINGDOM		EUROPE		OTHER		TOTAL	
	1969/ 1970	1973/ 1974	1969/ 1970	1973/ 1974	1969/ 1970	1973/ 1974	1969/ 1970	1973/ 1974	1969/ 1970	1973/ 1974	1969/ 1970	1973/ 1974
Physical Sciences	70 (37.2)	85 (50.6)	36 (19.1)	40 (23.8)	28 (14.9)	9 (5.4)	27 (14.4)	14 (8.3)	27 (14.4)	20 (11.9)	188 (100.0)	168 (100.0)
Mathematical Sciences	12 (41.4)	20 (51.3)	4 (13.8)	8 (20.5)	5 (17.2)	3 (7.7)	5 (17.2)	2 (5.1)	3 (10.3)	6 (15.4)	29 (100.0)	39 (100.0)
Engineering	11 (45.8)	23 (51.1)	2 (8.3)	7 (15.6)	1 (4.2)	1 (2.2)	6 (25.0)	4 (8.9)	4 (16.7)	10 (22.2)	24 (100.0)	45 (100.0)
Life Sciences	18 (46.2)	20 (55.6)	10 (25.6)	4 (11.1)	2 (5.1)	1 (2.8)	5 (12.8)	2 (5.6)	4 (10.3)	9 (25.0)	39 (100.0)	36 (100.0)
TOTAL	111 (39.6)	148 (51.4)	52 (18.6)	59 (20.5)	36 (12.9)	14 (4.9)	43 (15.4)	22 (7.6)	38 (13.6)	45 (15.6)	280 (100.0)	288 (100.0)

*: Percentage figures in brackets.

Source: Adapted from data of the Council of Ontario Universities.

TABLE 21

CAREER LOCATION OF POST-DOCTORAL STUDENTS
BY FIELD OF STUDY, 1972
(in percent)

Field of Study	In Canada	Outside Canada	Both	Total Number
Social Sciences	75.0	25.0	- -	12
Education	- -	100.0	- -	1
Humanities, Languages & Fine Arts	66.7	33.3	- -	6
Agriculture & Biological Sciences	66.7	28.3	5.0	60
Engineering & Applied Sciences	58.7	31.8	9.5	63
Mathematics and Physical Sciences	58.9	28.9	12.2	394
Health Professions & Occupations	73.7	26.3	- -	137
Total	62.8	28.7	8.5	673

Source: Tri-Council Survey, unpublished data.

TABLE 22

CAREER LOCATION OF POST-DOCTORAL STUDENTS
BY SELECTED DISCIPLINE, 1972
(in percent)

SELECTED DISCIPLINE	IN CANADA	OUTSIDE CANADA	BOTH	TO NUM
Psychology	85.7	14.3	- -	
Agriculture	80.0	20.0	- -	
Biology, Botany & Zoology	66.7	27.3	6.0	3
Computer Sciences, Applied Mathematics & Mathematics	66.7	22.2	11.1	2
Chemistry	53.4	33.6	13.0	23
Geology and Related	38.9	33.3	27.8	1
Physics	70.9	20.5	8.6	11

Source: Tri-Council Survey, unpublished data.